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(54) **SWITCH**

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H01H 21/24	(2006.01)
H01H 1/36	(2006.01)
H01H 21/12	(2006.01)
H01H 21/36	(2006.01)

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CPC ***H01H 21/14*** (2013.01); ***H01H 1/242*** (2013.01); ***H01H 1/36*** (2013.01); ***H01H 1/44*** (2013.01);

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USPC ..... 200/252, 16 R–16 D, 520, 530–536, 553, 200/557–559, 561–563, 276.1, 61.82, 8 R, 200/17 R, 260, 11 R, 335

See application file for complete search history.

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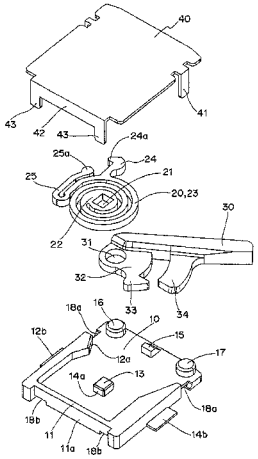
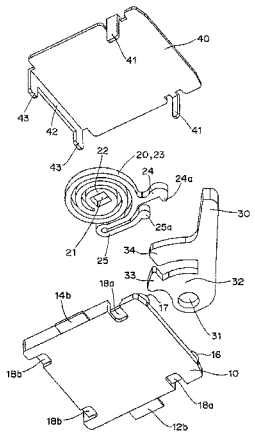
(57) **ABSTRACT**

A switch has a base having a frame integrally formed on a periphery of an upper face of the base, a fixed contact formed on an inner side face of the frame, and a support protrusion that protrudes from the upper face of the base that is integrally formed so as to expose a common fixed contact, an electrically conductive spring member whose connecting part arranged at a center of a spiral spring is nonrotatably supported by the support protrusion and that extends a driving piece from the free end of the spiral spring, and an actuating lever whose one end is rotatably supported by the upper face of the base and that integrally forms an actuating trigger that presses the driving piece of the electrically conductive spring member.

8 Claims, 6 Drawing Sheets





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CPC ***H01H 3/38*** (2013.01); ***H01H 21/12*** (2013.01); ***H01H 21/24*** (2013.01); ***H01H 21/36*** (2013.01); *H01H 2205/002* (2013.01); *H01H 2235/01* (2013.01)

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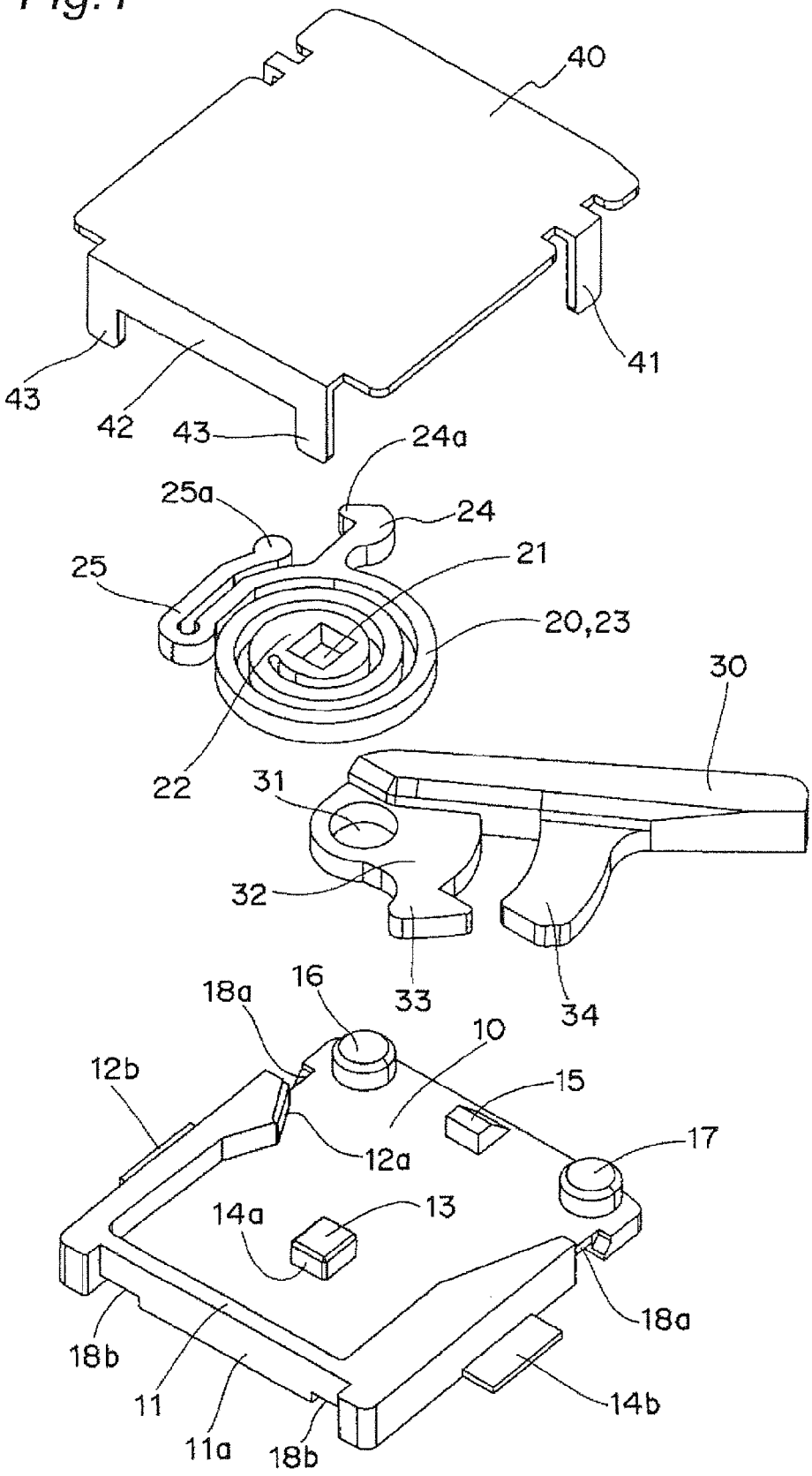
Fig. 1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14b

Fig.2

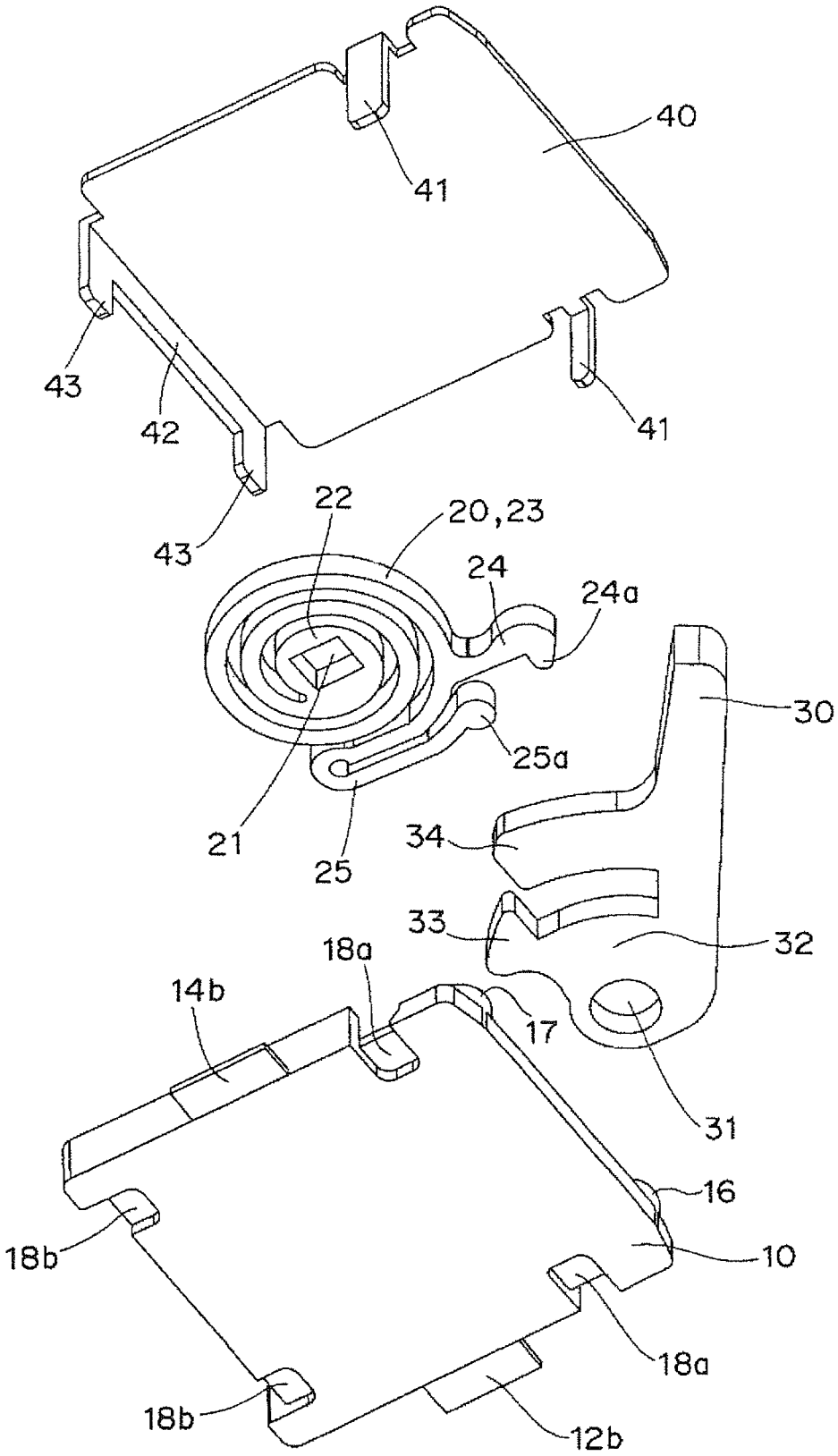
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Fig.3A

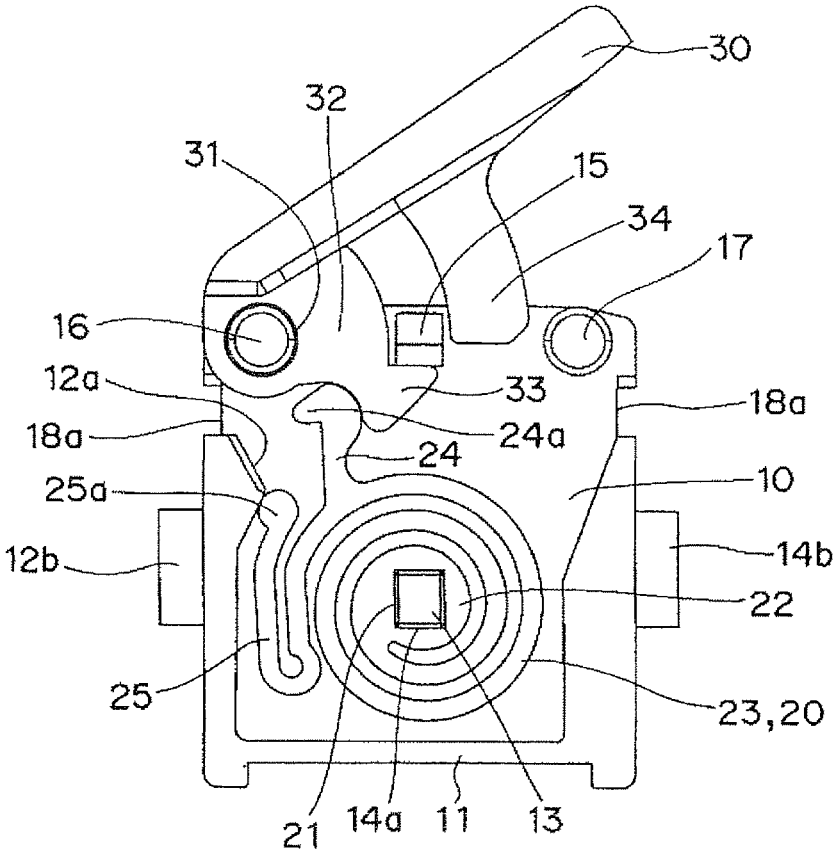
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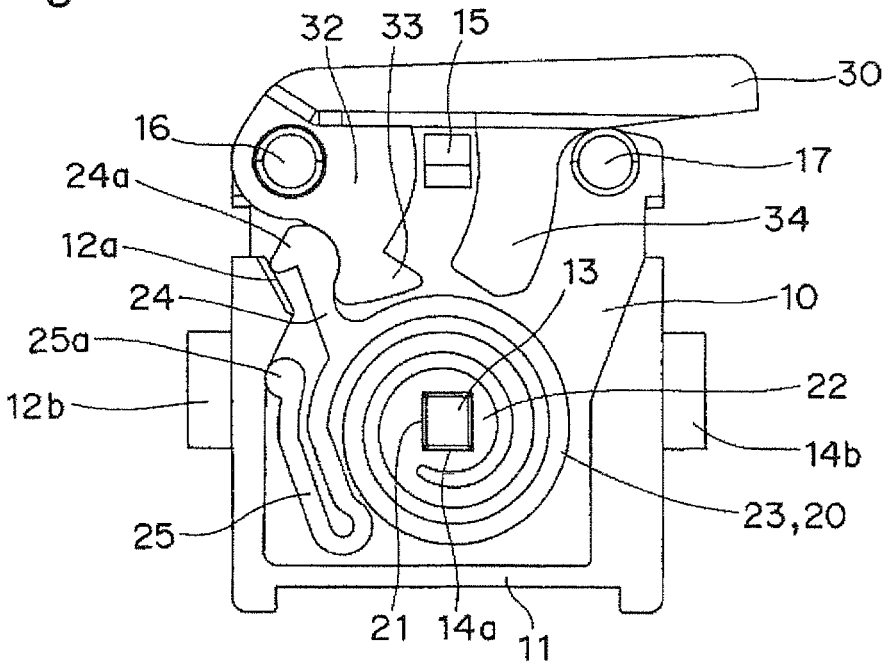
Fig.3B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14a
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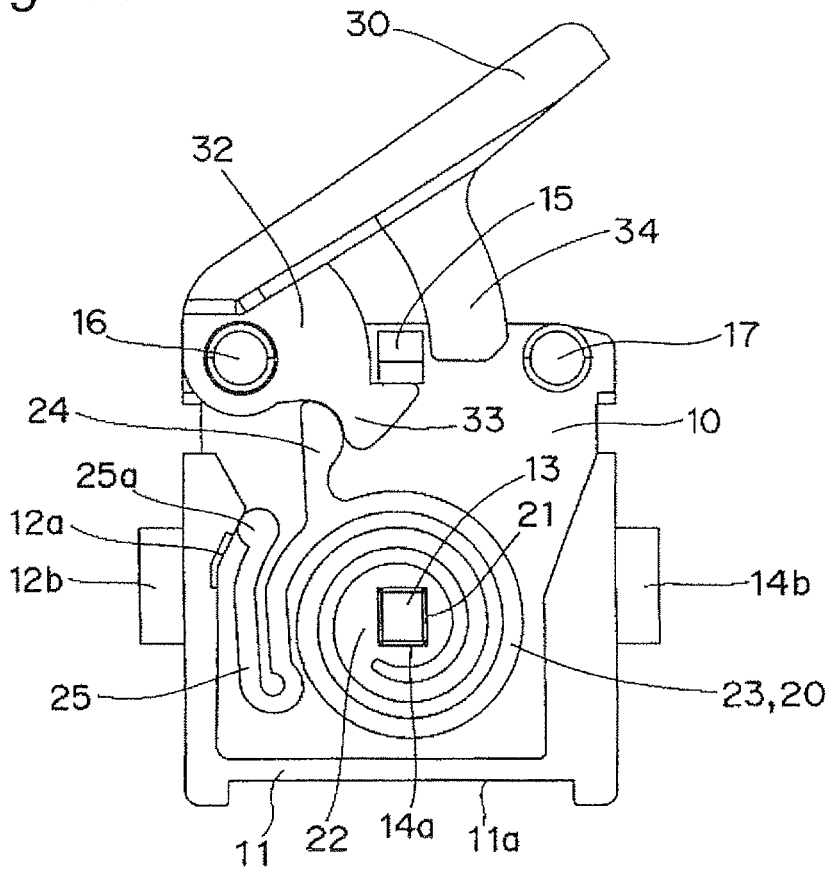
Fig.4A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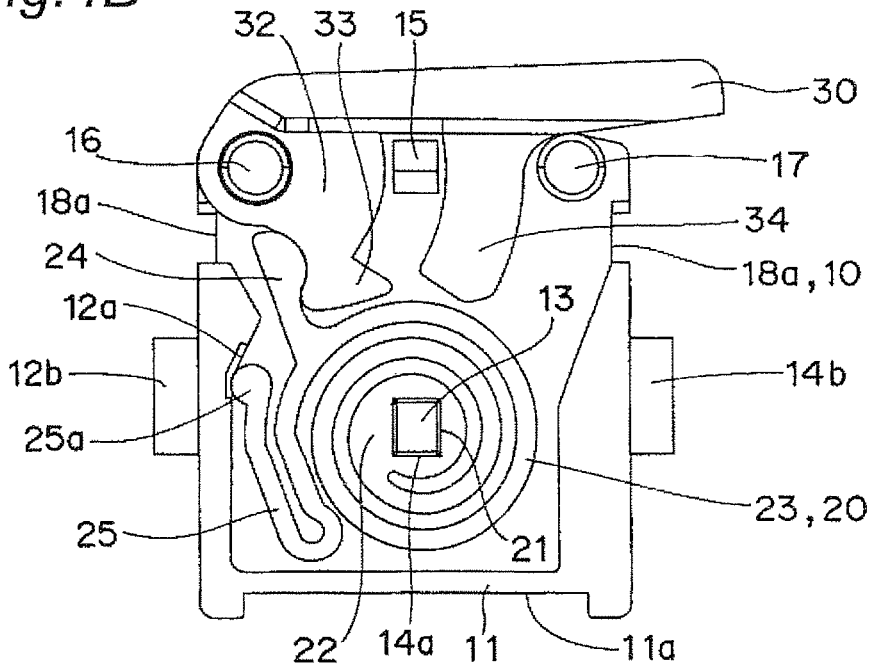
11a

Fig.4B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11a

Fig.5A

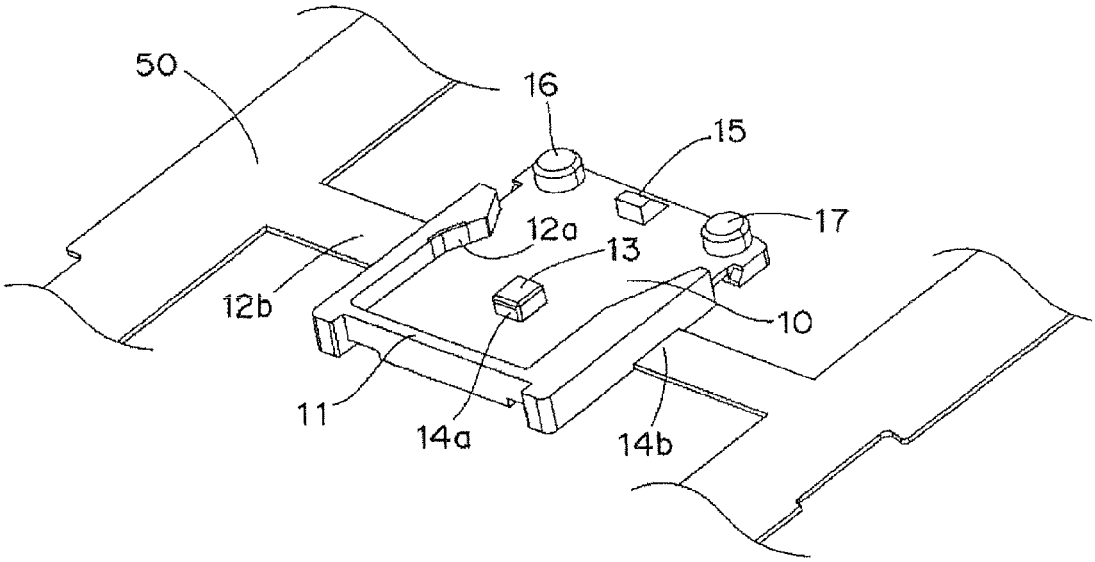

Fig.5B

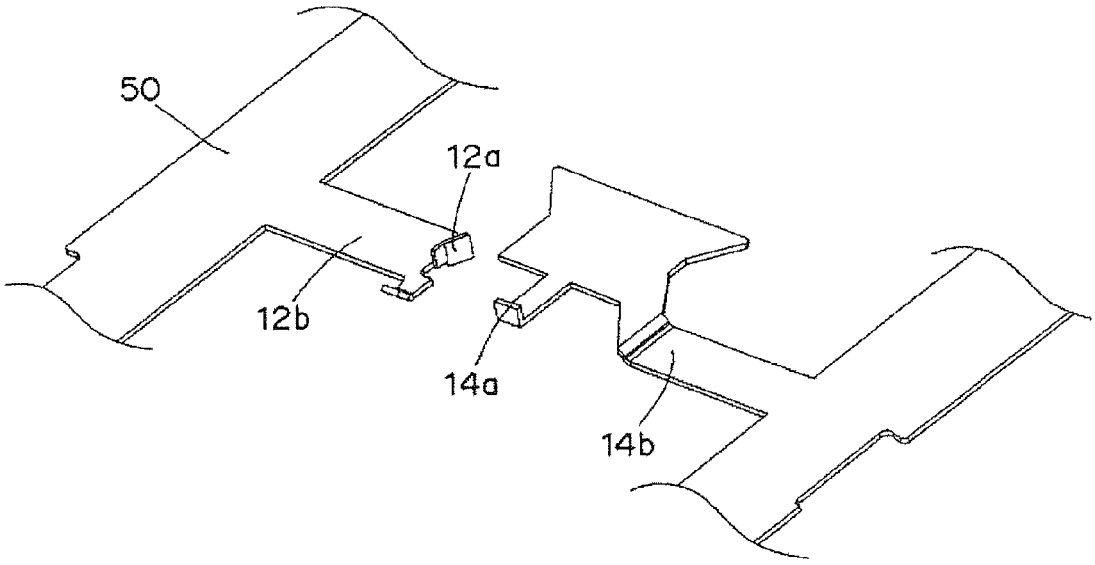

Fig.6A

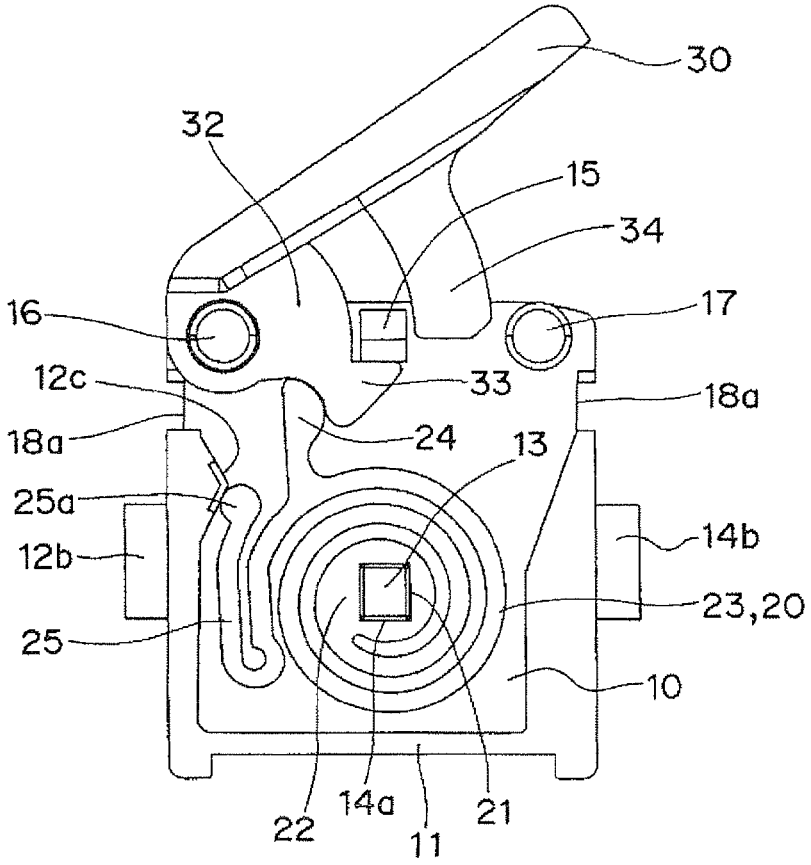
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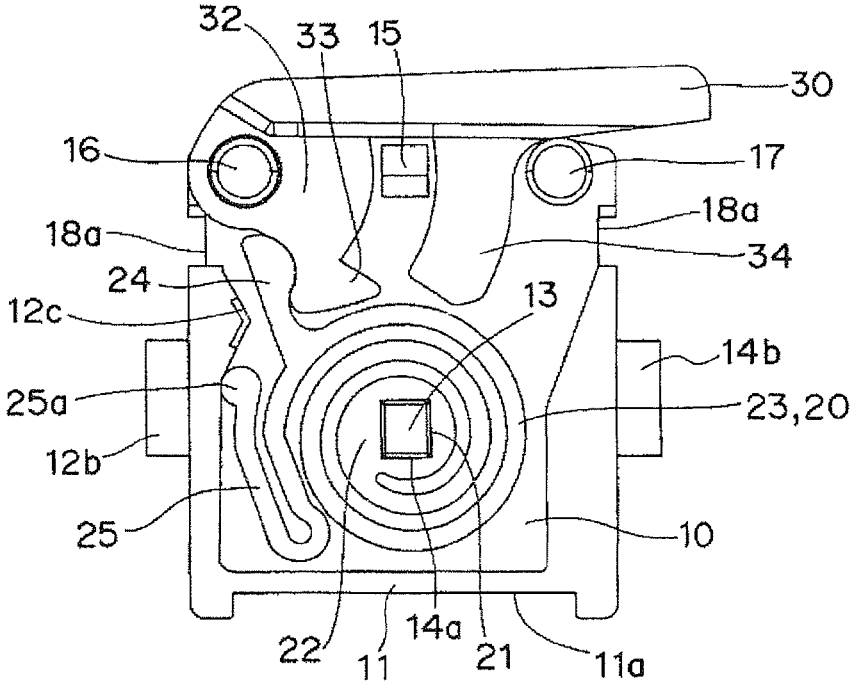
Fig.6B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14a
21
11a

SWITCH

BACKGROUND

1. Technical Field

The present invention relates to a switch, and in particular, to an ultrasmall thin switch for use in electronic devices such as mobile phones, smartphones, and digital cameras.

2. Related Art

A switch is known that includes, for example, a base, a movable contacting piece that includes a coil spring and whose one end is rotatably supported by the base, an actuating lever whose one end is pivotably supported by the base and that presses a coil of the movable contacting piece by a driving part that extends from the one end, and a cover that has a planar shape that can cover the base and is fixed to the base so as to compress the coil, in which the coil of the movable contacting piece is pressed by the actuating lever to impart a torsional moment, thereby causing the movable contacting piece to rotate about its one end, causing the coil of the movable contacting piece to slide on at least one fixed contact exposed out of the surface of a protrusion protruding from the bottom face of the base, and causing the other end of the movable contacting piece to slide on a common fixed contact exposed out of the inner side face of the base (refer to Patent Document 1).

CITATION LIST

Patent Document

Patent Document 1: Japanese Patent No. 4062319

SUMMARY

However, because the above switch ensures contact pressure using the spring force of the spiral coil spring, there is a limit to reducing a height dimension. It is not easy to mass-produce spiral coil springs having a complicated shape by press molding with high dimension accuracy, and hence, it is difficult to achieve an ultrasmall switch having a desired stroke and contact pressure.

An ultrathin switch according to one or more embodiments of the present invention has a small height dimension while ensuring a desired stroke and contact pressure.

A switch according to one or more embodiments of the present invention includes a base that forms a fixed contact on an inner side face of a frame integrally formed on a periphery of the upper face thereof and protrudes a support protrusion that is integrally formed so as to expose a common fixed contact on the upper face thereof; an electrically conductive spring member whose connecting part arranged at a center of a spiral spring is nonrotatably supported by the support protrusion and that extends a driving piece from the free end of the spiral spring; and an actuating lever whose one end is rotatably supported by the upper face of the base and that integrally forms an actuating trigger that presses the driving piece of the electrically conductive spring member. The fixed contact and the common fixed contact being electrically connected or disconnected through the electrically conductive spring member by rotating the actuating lever to press the driving piece of the electrically conductive spring member by the actuating trigger and elastically deforming the spiral spring thereby to cause the movable contact formed on the electrically conductive spring member to be connected or disconnected with the fixed contact.

One or more embodiments of the present invention, unlike conventional examples, eliminates the need for using a coil spring, thereby achieving a thin switch having a small height dimension.

The electrically conductive spring member is formed by the spiral spring, thereby achieving a switch that not only achieves a desired operation stroke but also facilitates uniform stress dispersion and resists a fatigue breakdown.

In one or more embodiments of the present invention, the movable contact may be formed at the tip of the driving piece, and the fixed contact and the common fixed contact may electrically be connected or disconnected through the electrically conductive spring member by rotating the actuating lever to press the driving piece of the electrically conductive spring member by the actuating trigger and elastically deforming the spiral spring thereby to cause the movable contact to be connected or disconnected with the fixed contact.

One or more embodiments of the present invention can press the movable contact formed on the driving piece directly against the fixed contact through the operative power of the actuating lever, thereby ensuring high contact pressure.

In one or more embodiments of the present invention, the driving piece and the movable contact may be formed at the free end of the spiral spring in a branched manner, and the fixed contact and the common fixed contact may electrically be connected or disconnected through the electrically conductive spring member by rotating the actuating lever to press the driving piece of the electrically conductive spring member by the actuating trigger and elastically deforming the spiral spring thereby to cause the movable contact to be connected or disconnected with the fixed contact.

One or more embodiments of the present invention can press the movable contact indirectly against the fixed contact through the driving piece, thereby achieving a switch that is easy to elastically deform and has a soft operation feeling.

In one or more embodiments of the present invention, the movable contact may be arranged at the tip of a return spring that extends from the free end of the electrically conductive spring member.

One or more embodiments of the present invention can bring the movable contact into contact with the fixed contact through the return spring, thereby achieving a switch having high contact reliability that is less likely to produce a contact failure even when vibration is applied.

In one or more embodiments of the present invention, the electrically conductive spring member and the actuating trigger of the actuating lever may have the same thickness dimension.

One or more embodiments of the present invention can house the electrically conductive spring member and the actuating lever within a space of the same height, thereby producing the effect of achieving a small-sized switch that is extremely thinner than conventional examples.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is an exploded perspective view illustrating a switch according to a first embodiment of the present invention.

FIG. **2** is an exploded perspective view of the switch illustrated in FIG. **1** viewed from a different angle.

FIG. **3**A and FIG. **3**B are elevational views of the switch illustrated in FIG. **1** before and after being operated, respectively.

FIG. **4**A and FIG. **4**B are elevational views of a switch according to a second embodiment of the present invention before and after being operated, respectively.

FIG. **5**A and FIG. **5**B are perspective views for illustrating the forming process of the switch illustrated in FIG. **4**.

FIG. **6**A and FIG. **6**B are elevational views of a switch according to a third embodiment of the present invention before and after being operated, respectively.

DETAILED DESCRIPTION

Embodiments of the present invention will be described with reference to the attached drawings of FIG. **1** to FIG. **6**B. In embodiments of the invention, numerous specific details are set forth in order to provide a more thorough understanding of the invention. However, it will be apparent to one of ordinary skill in the art that the invention may be practiced without these specific details. In other instances, well-known features have not been described in detail to avoid obscuring the invention.

As illustrated in FIG. **1** to FIG. **4**B, a switch of a first embodiment includes a base **10**, an electrically conductive spring member **20**, an actuating lever **30**, and a cover **40**. For the convenience of description, the cover **40** is not illustrated in FIGS. **3**A-**3**B.

As illustrated in FIG. **1**, the base **10** is integrally molded with a nearly U-shaped frame **11** extending along the periphery of a nearly square-shaped upper face. Insert-molded in the frame **11** is a normally open fixed contact **12***a* which is exposed on one end of the inner side of the frame **11**. The base **10** is also integrally molded with a quadrangular prism-shaped support protrusion **13** protruding nearly at the center of the upper face thereof, which has an inserted-molded common fixed contact **14***a* on sides thereof. The normally open fixed contact **12***a* and the common fixed contact **14***a* each include terminals **12***b*, **14***b*, respectively, protruding from the outer side face of the base **10**. The base **10** also includes a shaft **16** and a stopper **17** protruding from one periphery of the upper face thereof, between which a position restricting protrusion **15** is interposed.

The electrically conductive spring member **20** is manufactured by electroforming, in which a spiral spring **23** extends from a connecting part **22** that is positioned at the center and has a rectangular fitting hole **21**. The electrically conductive spring member **20** has a driving piece **24** and a nearly U-shaped return spring **25** both extending from the free end of the spiral spring **23**.

The fitting hole **21** formed in the connecting part **22** of the electrically conductive spring member **20** is fitted onto the support protrusion **13** of the base **10**, thereby bringing a tip **25***a* of the return spring **25** into pressure contact with the inner side face of the frame **11** (FIGS. **3**A-**3**B).

The shape of the support protrusion **13** and the fitting hole **21** is not limited to a quadrangle and is only required to be such a shape that the spiral spring **23** itself does not rotate or move when the spiral spring **23** expands and contracts.

As illustrated in FIG. **1**, the actuating lever **30** integrally forms an actuating trigger **32** having a shaft hole **31** at its one end, forms a nearly trapezoidal latch member **33** at the free end of the actuating trigger **32**, and integrally forms a guide arm **34** from its intermediate part.

As illustrated in FIGS. **3**A-**3**B, when the shaft hole **31** of the actuating lever **30** is fitted onto the shaft **16** of the base **10**, the actuating trigger **32** is in pressure contact with the driving piece **24** of the electrically conductive spring member **20** to be biased toward a return direction. This causes the latch member **33** of the actuating trigger **32** to engage with the position restricting protrusion **15** and is positionally restricted.

As illustrated in FIG. **1** and FIG. **2**, the cover **40** has a planar shape that can cover the surface of the base **10** and forms bending parts **41** at positions that can engage with notches **18***a* formed in two opposite sides of the base **10**. The cover **40** forms an engagement part **42** at a position that can fit into an engagement recess **11***a* formed in the frame **11**. Bending parts **43** that can engage with notches **18***b* formed in the base **10** are formed at both ends of the engagement part **42**.

The cover **40** is positioned against and covers the base **10** to which the electrically conductive spring member **20** and the actuating lever **30** are assembled. Next, the bending parts **41** of the cover **40** are bent to engage with the notches **18***a* of the base **10**. Furthermore, the engagement part **42** of the cover **40** engages with the engagement recess **11***a* of the frame **11**, and the bending parts **43** are bent to engage with the notches **18***b*, thereby preventing the electrically conductive spring member **20** and the actuating lever **30** from being disengaged.

Next, a method for operating the switch having the above components will be described.

As illustrated in FIG. **3**A, before actuation, the spring force of the nearly U-shaped return spring **25** brings the driving piece **24** of the electrically conductive spring member **20** into pressure contact with the actuating trigger **32** of the actuating lever **30** and biases the actuating lever **30** toward the return direction. However, the latch member **33** formed on the actuating trigger **32** of the actuating lever **30** is in contact with the position restricting protrusion **15** and is positionally restricted. In this situation, although the connecting part **22** of the electrically conductive spring member **20** is in contact with the common fixed contact **14***a*, a movable contact **24***a* formed at the tip of the driving piece **24** is not in contact with the normally open fixed contact **12***a* formed on the inner side face of the frame **11**.

When the free end of the actuating lever **30** is pressed down, the latch member **33** of the actuating trigger **32** presses the driving piece **24** with the shaft **16** as an axis, the spiral spring **23** of the electrically conductive spring member **20** is compressed, and the return spring **25** is compressed. This brings the movable contact **24***a* formed on the driving piece **24** into contact with the normally open fixed contact **12***a* and causes the common fixed contact **14***a* and the normally open fixed contact **12***a* to be electrically connected through the electrically conductive spring member **20**.

Next, when the pressing force on the actuating lever **30** is released, the actuating trigger **32** of the actuating lever **30** is pressed back through the spring force of the spiral spring **23** and the return spring **25** of the electrically conductive spring member **20**. This causes the actuating lever **30** to rotate in the opposite direction around the shaft **16** to return to the original position, disconnecting the movable contact **24***a* of the driving piece **24** from the normally open fixed contact **12***a*.

As illustrated in FIGS. **4**A-**4**B, the second embodiment of the present invention is nearly similar to the first embodiment and is different therefrom in that the tip of the nearly U-shaped return spring **25** is formed as the movable contact **25***a* and that the normally open fixed contact **12***a* is formed at a position with which and from which the movable contact **25***a* can come into on- or off-contact with the inner side face of the frame **11** of the base **10**. As illustrated in FIGS. **5**A and **5**B, the base **10** according to the second embodiment may be formed by insert molding with a lead frame **50**. Because the other is the same as the first embodiment, the same components will be referred to as the same reference numerals, and the description thereof will be omitted.

The second embodiment forms the movable contact **25***a* at the tip of the nearly U-shaped return spring **25**, thereby pressing the movable contact **25***a* against the normally open fixed contact **12***a* through the spring force of the return spring **25**. This brings about an advantage that a switch having high

contact reliability is achieved whose contact pressure is less likely to change even when vibration is applied.

As illustrated in FIGS. **6**A-**6**B, the third embodiment of the present invention is nearly similar to the first embodiment and is different therefrom in that the tip of the nearly U-shaped return spring **25** is formed as the movable contact **25***a* and that a normally closed fixed contact **12**C is formed at a position with which and from which the movable contact **25***a* can come into on- or off-contact with the inner side face of the frame **11** of the base **10**.

The third embodiment forms the movable contact **25***a* at the tip of the nearly U-shaped return spring **25**, thereby pressing the movable contact **25***a* against the normally closed fixed contact **12***c* through the spring force of the return spring **25**. This brings about an advantage that a switch having high contact reliability is achieved whose contact pressure is less likely to change even when vibration is applied.

It is understood that the switch according to one or more embodiments of the present invention can be used for, not only electronic devices such as mobile phones, other small-sized electronic devices such as digital cameras and video cameras.

While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

REFERENCE SIGNS LIST

10 Base
11 Frame
12*a* Normally open fixed contact
12*c* Normally closed fixed contact
13 Support protrusion
14*a* Common fixed contact
15 Position restricting protrusion
16 Shaft
17 Stopper
20 Electrically conductive spring member
21 Fitting hole
22 Connecting part
23 Spiral spring
24 Driving piece
24*a* Movable contact
25 Return spring
25*a* Movable contact
30 Actuating lever
31 Shaft hole
32 Actuating trigger
33 Latch member
40 Cover

The invention claimed is:

1. A switch, comprising:

a base comprising:

a frame integrally formed on a periphery of an upper face of the base,

a fixed contact formed on an inner side face of the frame, and

a support protrusion that protrudes from the upper face of the base that is integrally formed so as to expose a common fixed contact;

an electrically conductive spring member whose connecting part arranged at a center of a spiral spring is nonrotatably supported by the support protrusion and that extends a driving piece from the free end of the spiral spring; and

an actuating lever whose one end is rotatably supported by the upper face of the base and that integrally forms an actuating trigger that presses the driving piece of the electrically conductive spring member,

wherein the fixed contact and the common fixed contact are electrically connected or disconnected through the electrically conductive spring member by rotating the actuating lever to press the driving piece of the electrically conductive spring member by the actuating trigger and elastically deforming the spiral spring thereby to cause the movable contact formed on the electrically conductive spring member to be connected or disconnected with the fixed contact.

2. The switch according to claim **1**,

wherein the movable contact is formed at the tip of the driving piece, and

wherein the fixed contact and the common fixed contact are electrically connected or disconnected through the electrically conductive spring member by rotating the actuating lever to press the driving piece of the electrically conductive spring member by the actuating trigger and elastically deforming the spiral spring thereby to cause the movable contact to be connected or disconnected with the fixed contact.

3. The switch according to claim **1**,

wherein the driving piece and the movable contact are formed at the free end of the spiral spring in a branched manner, and

wherein the fixed contact and the common fixed contact are electrically connected or disconnected through the electrically conductive spring member by rotating the actuating lever to press the driving piece of the electrically conductive spring member by the actuating trigger and elastically deforming the spiral spring thereby to cause the movable contact to be connected or disconnected with the fixed contact.

4. The switch according to claim **3**, wherein the movable contact is arranged at the tip of a return spring that extends from the free end of the electrically conductive spring member.

5. The switch according to claim **1**, wherein the electrically conductive spring member and the actuating trigger of the actuating lever have the same thickness dimension.

6. The switch according to claim **2**, wherein the electrically conductive spring member and the actuating trigger of the actuating lever have the same thickness dimension.

7. The switch according to claim **3**, wherein the electrically conductive spring member and the actuating trigger of the actuating lever have the same thickness dimension.

8. The switch according to claim **4**, wherein the electrically conductive spring member and the actuating trigger of the actuating lever have the same thickness dimension.

* * * * *